

Location-Aware, Low-Power, Wearable Wireless Sensing for Environmental Monitoring

Completed Technology Project (2012 - 2013)



Project Introduction

Frequent, short-term crew exposure to elevated CO₂ levels combined with other physiological impacts of microgravity may lead to a number of detrimental effects, including loss of vision. This technology project seeks to develop a prototype of a real-time location system integrated with a CO₂ sensor to monitor and correlate space-time-CO₂ concentration with physical symptoms and functional evaluations of impairment. The CO₂ sensor will be integrated with a low-power ultra-wideband (UWB) communication system with location-tracking capability. Although the initial development is oriented to the measurement of CO₂, the system concept can easily be adapted to accommodate other types of sensors.

Recent findings indicate that frequent, short-term crew exposure to elevated CO₂ levels combined with other physiological impacts of microgravity may lead to a number of detrimental effects, including loss of vision. To evaluate the risks associated with transient elevated CO₂ levels and design effective countermeasures, doctors must have access to frequent CO₂ measurements in the immediate vicinity of individual crew members along with simultaneous measurements of their location in the space environment. To achieve this goal, a small, low-power, wearable system that integrates an accurate CO₂ sensor with an ultra-wideband (UWB) radio capable of real-time location estimation and data communication is proposed. This system would be worn by crew members and would automatically gather and transmit sampled sensor data tagged with real-time, high-resolution location information. Under the current proposed effort, a breadboard prototype of such a system will be developed. Although the initial effort is targeted to CO₂ monitoring, the concept is applicable to other types of sensors. For the initial effort, existing EV Modular Instrumentation System (MIS) Wireless Sensor Network (WSN) hardware will be leveraged to integrate a low-power CO₂ sensor with a commercially available UWB radio system with ranging capability. In addition, potential for integration of this system with EV's Electronic-textile System for the Evaluation of Wearable Technology (E-SEWT) will be evaluated.

Anticipated Benefits

Following development and testing in several JSC labs to characterize location accuracy with CO₂ sensors, a garment can be created to integrate electronics with sensor for CO₂ mapping on ISS or future exploration missions. The system can be expanded to include other sensors, such as noise, O₂, or other bio-telemetry data, that must be correlated with localization data. In addition, aspects of the technology can be applied to other applications where location-tagged environmental data is required from a mobile device.



Project Image Location-Aware, Low-Power, Wearable Wireless Sensing for Environmental Monitoring

Table of Contents

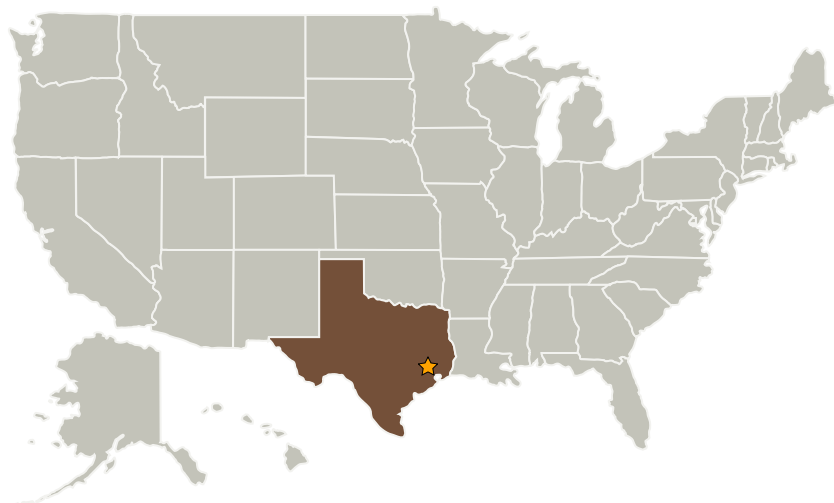
Project Introduction	1
Anticipated Benefits	1
Primary U.S. Work Locations and Key Partners	2
Organizational Responsibility	2
Project Management	2
Images	3
Technology Maturity (TRL)	3
Technology Areas	3

Location-Aware, Low-Power, Wearable Wireless Sensing for Environmental Monitoring

Completed Technology Project (2012 - 2013)



Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★ Johnson Space Center(JSC)	Lead Organization	NASA Center	Houston, Texas

Primary U.S. Work Locations

Texas

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Johnson Space Center (JSC)

Responsible Program:

Center Innovation Fund: JSC CIF

Project Management

Program Director:

Michael R Lapointe

Program Manager:

Carlos H Westhelle

Project Manager:

David S Hafermalz

Principal Investigator:

David S Hafermalz

Location-Aware, Low-Power, Wearable Wireless Sensing for Environmental Monitoring

Completed Technology Project (2012 - 2013)



Images



12094-1376604392820.jpg

Project Image Location-Aware, Low-Power, Wearable Wireless Sensing for Environmental Monitoring
(<https://techport.nasa.gov/image/2222>)



12094-1376604443592.jpg

Project Image Location-Aware, Low-Power, Wearable Wireless Sensing for Environmental Monitoring
(<https://techport.nasa.gov/image/2223>)

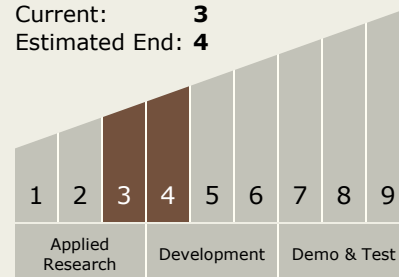


12094-1376605515791.png

Project Image Location-Aware, Low-Power, Wearable Wireless Sensing for Environmental Monitoring
(<https://techport.nasa.gov/image/2224>)

Technology Maturity (TRL)

Start: **3**
Current: **3**
Estimated End: **4**



Technology Areas

Primary:

- TX06 Human Health, Life Support, and Habitation Systems
 - └ TX06.4 Environmental Monitoring, Safety, and Emergency Response
 - └ TX06.4.1 Sensors: Air, Water, Microbial, and Acoustic